S
388.11
H3eg

STATE DOCUMENTS

MONTANA STATE HIGHWAY DEPARTMENT
HIGHWAY PLANNING SURVEY
IN COOPERATION WITH
PUBLIC ROADS ADMINISTRATION

*********
*************
*********

# ECONOMIC ANALYSIS AND RECOMMENDATIONS RELATIVE TO PROPOSED CUT-OFF, GORE HILL TO 10th AVENUE SOUTH BY-PASS IN GREAT FALLS, MONTANA

MONTANA STATE LIBRARY
930 East Lyndale Avenue
Helena, Montana 59601

February 1946

Montana State Library
3 0864 1006 2279 7

MONTANA STATE HIGHWAY DEPARTMENT

HIGHWAY PLANNING SURVEY

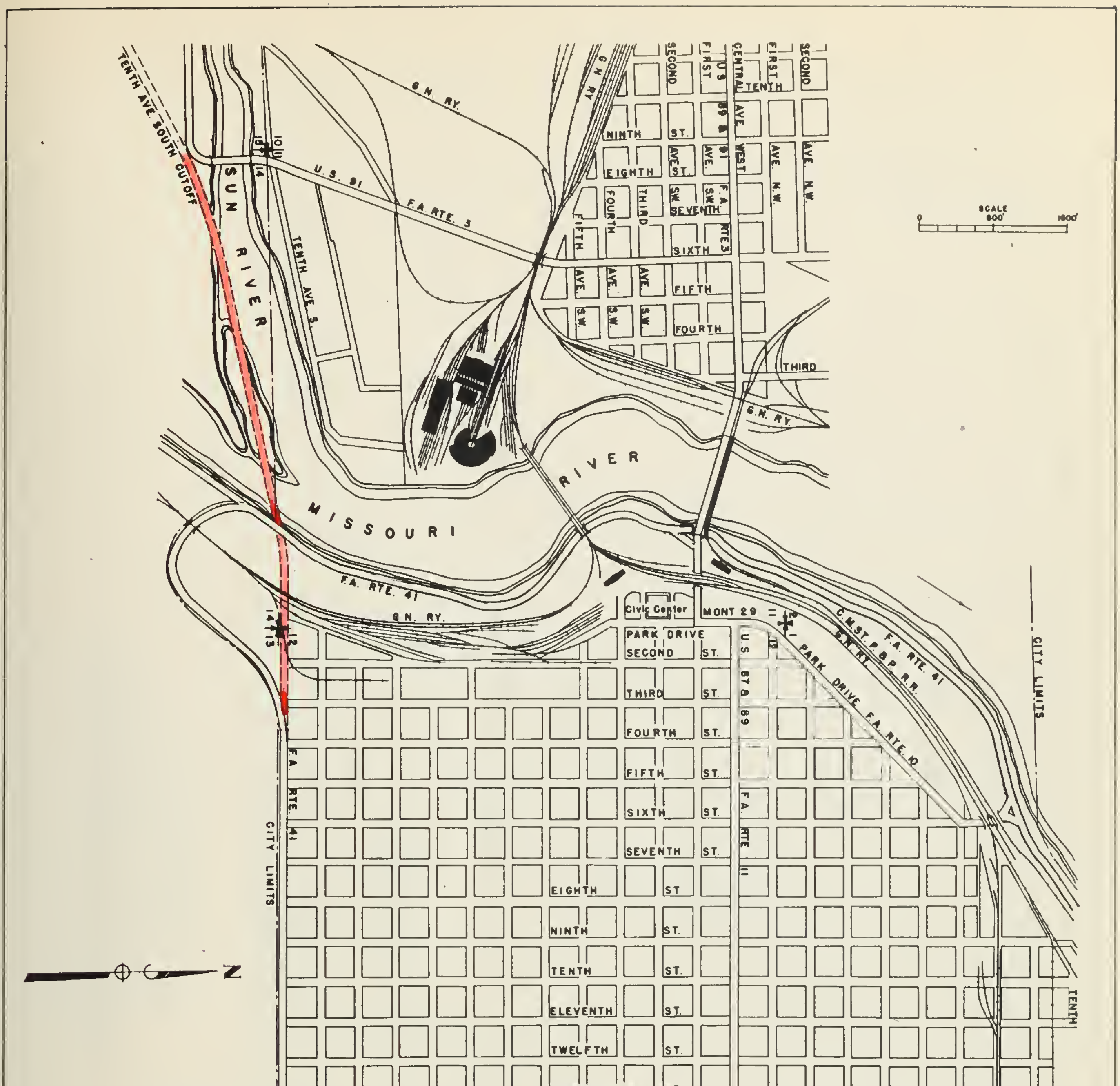
IN COOPERATION WITH

PUBLIC ROADS ADMINISTRATION

*********
*************
*********

# ECONOMIC ANALYSIS AND RECOMMENDATIONS RELATIVE TO PROPOSED CUT-OFF, GORE HILL TO 10th AVENUE SOUTH BY-PASS IN GREAT FALLS, MONTANA

February 1946


TENTH AVE. SOUTH CUTOFF
SUN RIVER
MISSOURI RIVER
G.N. RY.
U.S. 91
F.A. RTE. 3
TENTH AVE. S.
F.A. RTE. 41
CENTRAL AVE. WEST
U.S. 89 & 91
Civic Center
MONT 29
PARK DRIVE
U.S. 87 & 89
F.A. RTE. 11
C.M.ST.P.&P. R.R.
PARK DRIVE F.A. RTE. 10
CITY LIMITS
SCALE
0
800'
1600'
N
T.20N.
R.3E.
T.20N.
R.4E.
SECOND
THIRD
FOURTH
FIFTH
SIXTH
SEVENTH
EIGHTH
NINTH
TENTH
ELEVENTH
TWELFTH
THIRTEENTH
FOURTEENTH
SIXTEENTH
SEVENTEENTH
EIGHTEENTH
NINETEENTH
TWENTIETH
TWENTY FIRST
TWENTY SECOND
TWENTY THIRD
TWENTY FOURTH
ST.
CENTRAL
FIRST
AVE.
S.
N.
AVE. S.W.
AVE. N.W.

Montana State Highway Department
Traffic and Planning Section
Public Roads Administration
Basic Design Categories
Table No. 1

| Standard | Average Daily Traffic | Classification | Max. Grade | Max. Curvature (Degree) | Sight Distance | | | | Shoulder Width | Width of Road Bed at Grade | Width of Surfacing | Minimum Type of Surfacing | Minimum Base Course |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Non Passing | | | Passing | | | | | |
| | | | | | Horiz. Curvature (Degree) | Vertical Curvature (Algebraic Difference) | Feet | Feet | | | | | |
| 0 | 0-200 | 20 M 40 | 7 | 14 | 14 | SEE TABLE NO. 2. | 280 | 800 | 3 | 24 | 18 | Under 1" Oil | 5" |
| 1 | 201-400 | 50 M 40 | 7 | 14 | 14 | | 290 | 800 | 4 | 28 | 20 | 2" Oil | 6" |
| 2 | 401-800 | 100 M 40 | 7 | 14 | 14 | | 310 | 1100 | 5 | 32 | 22 | 2½" Oil | 8" |
| 3 | 801-1800 | 200 M 40 | 7 | 14 | 14 | | 320 | 1100 | 6 | 34 | 22 | 2½" Oil | 8" |
| 4 | 1801-3500 | 300 M 40 | 7 | 14 | 14 | | 330 | 1100 | 8 | 38 | 22 | 2½" Oil | 8" |
| 5 | 0-200 | 20 M 60 | 6 | 6 | 6 | | 460 | 1700 | 3 | 26 | 20 | Under 1" Oil | 5" |
| 6 | 201-400 | 50 M 60 | 6 | 6 | 6 | | 460 | 1700 | 4 | 30 | 22 | 2" Oil | 6" |
| 7 | 401-800 | 100 M 60 | 6 | 6 | 6 | | 470 | 2100 | 5 | 32 | 22 | 2½" Oil | 8" |
| 8 | 801-1800 | 200 M 60 | 6 | 6 | 6 | | 480 | 2100 | 6 | 34 | 22 | 2½" Oil | 8" |
| 9 | 1801-3500 | 300 M 60 | 6 | 6 | 6 | | 500 | 2100 | 8 | 38 | 22 | 2½" Oil | 8" |

Note: Roads having over 3500 vehicles per day require special design.

## TABLE NO. 2

Table giving length of vertical curve required for various
Non - passing sight distances

December 18, 1943

| Algebraic Difference between grades for convex curvature. | Length of vertical curve for a Non-passing sight distance of: 280 feet | Length of vertical curve for a Non-passing sight distance of: 290 feet | Length of vertical curve for a Non-passing sight distance of: 310 feet | Length of vertical curve for a Non-passing sight distance of: 320 feet | Length of vertical curve for a Non-passing sight distance of: 330 feet | Length of vertical curve for a Non-passing sight distance of: 460 feet | Length of vertical curve for a Non-passing sight distance of: 470 feet | Length of vertical curve for a Non-passing sight distance of: 480 feet | Length of vertical curve for a Non-passing sight distance of: 500 feet |
|---|---|---|---|---|---|---|---|---|---|
| 1.00 | 96 | 103 | 117 | 125 | 133 | 258 | 269 | 281 | 305 |
| 2.00 | 191 | 205 | 234 | 250 | 266 | 516 | 539 | 562 | 610 |
| 3.00 | 287 | 308 | 352 | 375 | 398 | 774 | 808 | 843 | 915 |
| 4.00 | 382 | 410 | 469 | 500 | 531 | 1032 | 1078 | 1124 | 1220 |
| 5.00 | 478 | 513 | 586 | 624 | 664 | 1290 | 1347 | 1405 | 1524 |
| 6.00 | 574 | 615 | 703 | 749 | 797 | 1548 | 1616 | 1686 | 1829 |
| 7.00 | 669 | 718 | 820 | 874 | 930 | 1806 | 1886 | 1967 | 2134 |
| 8.00 | 765 | 820 | 938 | 999 | 1062 | 2064 | 2155 | 2248 | 2439 |
| 9.00 | 860 | 923 | 1055 | 1124 | 1195 | 2322 | 2425 | 2529 | 2744 |
| 10.00 | 956 | 1026 | 1172 | 1249 | 1328 | 2581 | 2694 | 2810 | 3049 |
| 11.00 | 1052 | 1128 | 1289 | 1374 | 1461 | 2839 | 2963 | 3091 | 3354 |
| 12.00 | 1147 | 1231 | 1406 | 1499 | 1594 | 3097 | 3233 | 3372 | 3659 |
| 13.00 | 1243 | 1333 | 1524 | 1623 | 1726 | 3355 | 3502 | 3653 | 3963 |
| 14.00 | 1339 | 1436 | 1641 | 1748 | 1859 | 3613 | 3771 | 3934 | 4268 |

Digitized by the Internet Archive
in 2012 with funding from
Montana State Library

http://archive.org/details/economicanaly2497mont

## MONTANA HIGHWAY PLANNING SURVEY

## GUIDES FOR ESTIMATING 1960 TRAFFIC

| | | | Applies to: |
|---|---|---|---|
| 1. | 100% | = 1941 traffic. | |
| 2. | 110% to 125% | = Traffic if route is unimproved at present time but expected to be improved by 1960. | F.A., F.A.S. and Class 1, 2, & 3 Forest Highways. Applies to sparcely settled rural areas.<br>(Add extra traffic generated by logging activities on timber utilization roads or other major industries and traffic induced by these activities). |
| 3. | 125% to 150% | = Traffic if route is unimproved at present time but expected to be improved by 1960. | F.A., F.A.S. and Class 1, 2, & 3 Forest Highways. Applies in checkerboard well-settled rural areas or on through-roads.<br>(Add extra traffic generated by logging activities on timber utilization roads or other major industries and traffic induced by these activities). |
| 4. | 150% to 200% | = Traffic if route is unimproved at present time but expected to be improved by 1960. | F.A., F.A.S. and Class 1, 2, & 3 Forest Highways. This applies in exceptional cases such as bottlenecks and natural cutoffs. Some cases, of course, might be much more but these special conditions would require special analysis.<br>(Add extra traffic generated by logging activities on timber utilization roads or other major industries and traffic induced by these activities). |

Note: Date of expected improvement does not change traffic estimates for 1960.

---

130% = expected secular growth 1941 to 1960 -- to be applied to all above conditions except traffic generated by logging activities, or other major industries.

Applies to all roads now constructed.
(Without any of above increases)

---

Average summer maximum traffic equals double average ADT except on predominately recreational routes where factor might be as high as 3.

Average summer maximum traffic equals average of several maximum summer days.

Maximum hour equals 10% of maximum summer ADT. (Usual public traffic), or 15 to 20% on roads used by both the public and by major logging operations or other major industries.

## TABLE OF CONTENTS

Page

Map . . . . . . . . . . . . . . . . . . . . . . . . . . Frontispiece

Basic Design Categories . . . . . . . . . . . . . . . . . . i-ii

Guide for Estimating Traffic . . . . . . . . . . . . . . . iii

I. SUMMARY OF FINDINGS . . . . . . . . . . . . . . . . . 1-2

Limitations of Economic Analyses - Discussion of Benefits - Statement of Policy.

II. ROUTE DESCRIPTION . . . . . . . . . . . . . . . . . . 2-3

III. TRAFFIC DATA . . . . . . . . . . . . . . . . . . . . 3-9

Association of Traffic and Vocational Pursuits - Statement of Traffic Problem - Relief of Congestion - Origin - Destination of Traffic - Diversionary Traffic - Classification of Traffic.

IV. ECONOMIC ANALYSIS . . . . . . . . . . . . . . . . . . 9-35

A. Annual Cost Calculations . . . . . . . . . . . . . . 9-11
Development of Costs, Construction - Estimate of Maintenance Charges - Tabulation, Annual Cost Calculations.

B. AVERAGE DAILY TRAFFIC, 1960 . . . . . . . . . . . . 12-22
Classification by Origin - Destination
1. Outside Traffic . . . . . . . . . . . . . . . . . 12-18
   a. Passenger Cars . . . . . . . . . . . . . . . . 13
      (1) through (9) . . . . . . . . . . . . . . . 13-15
         Classification by Travel Routes
   b. Light Trucks . . . . . . . . . . . . . . . . . 15
      (1) through (9) . . . . . . . . . . . . . . . 15-16
         Classification by Travel Routes
   c. Medium and Heavy Trucks and Trailer Cominations . . . . . . . . . . . . . . . . . . 16
      (1) through (4) . . . . . . . . . . . . . . . 16-17
         Classification by Travel Routes
   d. Busses . . . . . . . . . . . . . . . . . . . . 17
      Increase over that volume cited in Section III
      (1) and (2) . . . . . . . . . . . . . . . . . 17-18
         Classification by Travel Routes
2. Added Traffic . . . . . . . . . . . . . . . . . . 18-20
   a. Passenger Cars . . . . . . . . . . . . . . . . 18
      (1) through (4) . . . . . . . . . . . . . . . 18-19
         Classification by Travel Routes
   b. Light Trucks . . . . . . . . . . . . . . . . . 19
      (1) through (4) . . . . . . . . . . . . . . . 19
         Classification by Travel Routes

c. Medium and Heavy Trucks and Trailer Combinations . . . . . . . . . . . . . . . . . . . . . . 20
(1) through (3). . . . . . . . . . . . . . . . . . . . . . . 20
Classification by Travel Routes
d. Busses . . . . . . . . . . . . . . . . . . . . . . . . . 20
(1) through (3). . . . . . . . . . . . . . . . . . . . . . . 20
3. Traffic Summary, 1960 . . . . . . . . . . . . . . . . . . . 20-23
Tabulation of Estimated Average Daily Traffic, 1960 . . . . . . . . . . . . . . . . . . 21
Traffic Flow Chart . . . . . . . . . . . . . . . . . . . . 22a-23
Discussion of Effect of Construction of Cut-off
C. Annual Revenues . . . . . . . . . . . . . . . . . . . . . . . 22-26
Source of Basic Data - Estimate of Income, 1960- Discussion - Tabulation.

D. Time Element Savings . . . . . . . . . . . . . . . . . . . . 26-29
Factors which Operate to Effect Time Element Savings - Source of Basic Data - Discussion - Tabulation - "SLOWS" and "STOPS".

E. Mileage Element Savings . . . . . . . . . . . . . . . . . . 30-32
Factors which Operate to Effect Mileage Element Savings - Discussion - Tabulation - Derivation of Formulae.

F. Traffic Benefits . . . . . . . . . . . . . . . . . . . . . 33
Allocation of Benefits by Function.

G. Derivation of Quotients . . . . . . . . . . . . . . . . . . 33-35
Explanation of the Variables involved in the Derivation of the Several Quotients - Significance of Each of the Several Quotients. 35

V. RECOMMENDATIONS . . . . . . . . . . . . . . . . . . . . . . . . 35

Project be Tabled Pending Stabilization of Highway Problems in General Area Contiguous to and Feeding to Great Falls and Cascade County.

# APPLICATION OF THE OREGON
# SOLVENCY QUOTIENT METHOD TO DETERMINE
# THE ECONOMIC FEASIBILITY OF
# CONSTRUCTION OF THE 10th AVENUE
# SOUTH CUTOFF IN GREAT FALLS, MONTANA

## I. SUMMARY OF FINDINGS

Herewith report as per title above using the principles of the Oregon solvency quotient method. By setting up a mathematical relationship between estimated costs on the one hand and possible future income and benefits on the other, an index of economic feasibility is established to aid us in designing our future highway construction program. Every one of the factors involved in the derivation of these solvency quotients grows out of, or is influenced by, the economics of the area feeding to or touching on the Great Falls trade area which this proposed improvement will serve. (This statement of theory will be further amplified and developed in the latter sections of this analysis). In any event, the course of action recommended by the application of the solvency quotient method will be premised on a business-like procedure, and it follows, obviously, that such action will be in the greatest economic interest of the public at large within certain limits.

In this particular case the proposed cut-off is economically feasible as will be shown in Section IV, sub-section G. The time element savings alone operate to place the job on a solvent basis, this despite a tremendous "plant" investment, some $640,000, without interest. By reason of the fact that the time element savings are "non-automotive", so to speak, in characteristic it now becomes a matter of policy as to whether or not

the cut-off should be built. This policy would consider the nature and characteristic of the benefits involved - if for example, there is a site for highway improvement in the city which would develop greater "automotive" savings, mileage element savings as we call them in Section IV; then, in consideration of our assignment as a road-building agency, it would be the better policy to build at that site, even though the solvency quotient were lower than that manifested for the cut-off. By so operating we would be going against the obvious suggestion of the economic analysis but we would be serving in the particular interest of the road user, the person who is concerned with surface condition, distance savings, rise and fall, gradient, etc., all of which brings our previously mentioned "policy" around to consideration of the condition of the roads in other areas of the state. This report will not treat with the over-all requirements of our highway system - suffice it to say, we have obligated ourselves as a road building agency to keep the road user up on a high type surface, and benefits or lack of benefits notwithstanding, we plan to keep him there. In short, the road system deficiencies might operate to gain priority in the programming of funds for highway construction.

In summary, the 10th Avenue South Cut-off is eminently qualified for construction by reason of a high solvency quotient but a rational, conservative highway policy would recommend that it be tabled pending general stabilization of highway problems in other areas.

## II. ROUTE DESCRIPTION

The route as proposed for construction extends from a point near the Sun River Bridge on the south bank of the river to a junction with the existing 10th Avenue South By-pass near Fourth Street in Great Falls. The

line traverses the full length of the Country Club island; the river crossing will require a bridge some 1,200 feet in length, over-passes will require approximately 280 feet of construction. It is probable that the approaches to the bridge will average some 10 feet in height. The over-all length of the improvement will be 1.3 miles.

That traffic which will use the cut-off now travels over the Sun River Bridge and US-91 to Central Avenue West, thence by way of the First Avenue North Bridge to and through the business district of Great Falls by way of US-87-89.

## III. TRAFFIC DATA

Great Falls is a distribution center for a varied assortment of our Montana commodities - in the preparation of this analysis we are interested in the effect of such an industry as it relates to traffic which might be diverted to the proposed improvement. It so happens that the principle warehouse district is located east of the Missouri River and south of First Avenue North between Fourth Street and Park Drive. For that traffic south-bound or from the south which must start or end a trip in the warehouse district, there is necessarily a devious and winding approach to the area. All of which culminates in entry upon the congested easterly approaches to the First Avenue North bridge. We are reasonably assured that the First Avenue North bridge is sufficient in capacity to accommodate all traffic which can be foreseen or forecast in the next several years - it is the aforementioned approaches which presently limit the useful service life of the bridge.

It is obvious, Great Falls being the settled, stabilized community that it is, that the warehouse district will remain where it is, that the

shopping and business district will not move to solve a traffic problem, and that the preponderance of Great Falls residential dwellers will continue to live east of the river. It remains for us, the highway people, to solve the traffic problems to thus extend the service life of the First Avenue North bridge, to relieve the congestion on the easterly approaches to that bridge and on the bridge proper and to improve over-all traffic conditions in Great Falls in general. In regard to the latter mentioned condition or end-point in the solution of the problem; we want to spread the traffic, we want to reduce it to a lower level on a greater number of streets. Such a condition of traffic dispersion is attainable because the north-south streets between Tenth Avenue South and First Avenue North are all paved - traffic would take to these streets with no degree of hesitation.

With these conditions existing we next turn to an examination of traffic records at hand and on file in the offices of the Montana Highway Department, Planning Section, and find that the easterly and southerly approaches to Great Falls contribute the greatest volumes of outside traffic to the streets of that city and in November 1945 this traffic was surveyed with a view to ascertaining how much of the traffic would use the Tenth Avenue South cutoff, if built. Two interview stations were selected, one on US-91 near the summit of Gore Hill southwest of the Gore Field approach road, and the other on US-87-89 east of its junction with the existing Tenth Avenue South By-pass. At each station traffic was stopped and the drivers were questioned as to their origin-destination for the trip on which they were presently engaged and in addition, they were asked if they would use the new approach to the city, if built. These data were related to a coincident classification and volume count to arrive at estimates as follows:

## VEHICLES THAT WILL USE TENTH AVENUE SOUTH CUT-OFF

### INTERVIEWED AT GORE HILL STATION

| | Pass. | Light Trucks | | Medium Trucks | | Heavy Trucks | | T.T. - S.T. | | Truck-Full T. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Busses | Total |
| 1941 ADT Ulm Leg | 616 | 42 | 57 | 5 | 5 | 5 | - | 12 | 5 | 3 | 2 | 4 | 756 |
| 1941 ADT Airport road | 195 | 11 | 9 | | | | | | | | | | 215 |
| Combined Traffic - 1941 | 811 | 53 | 66 | 5 | 5 | 5 | | 12 | 5 | 3 | 2 | 4 | 971 |
| Est. 1960 ADT that will cross new bridge 1/ | 1054 | 69 | 86 | 7 | 6 | 7 | | 15 | 6 | 4 | 3 | 5 | 1262 |
| **INTERVIEWED AT EAST STATION** | | | | | | | | | | | | | |
| 1941 Traffic (Thru East Station) | 116 | 16 | 26 | | | | | 6 | 3 | | | 4 | 171 |
| Est. 1960 Traffic that will cross new bridge | 150 | 21 | 34 | | | | | 8 | 4 | | | 5 | 222 |

---

1/ In recognition of a possible 30% increase of traffic by 1960. See Guide to Traffic Estimation, page iii.

## VEHICLES THAT WILL CROSS FIRST AVENUE NORTH BRIDGE (1960)

### INTERVIEWED AT GORE HILL STATION

| | Pass | Light Trucks | | Medium Trucks | | Heavy Trucks | | T.T. - S.T. | | Truck-Full Tr. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Busses | Total |
| 1941 ADT Ulm Leg | 98 | 5 | 10 | | | | | 2 | | | | 4 | 119 |
| 1941 ADT Airport | 30 | 1 | 2 | | | | | | | | | | 33 |
| 1941 Combined Traffic | 128 | 6 | 12 | | | | | 2 | | | | 4 | 152 |
| Est. 1960 ADT across 1st Ave. North | 166 | 8 | 16 | | | | | 3 | | | | 5 | 198 |
| **INTERVIEWED AT EAST STATION** | | | | | | | | | | | | | |
| 1941 ADT | 42 | 1 | 7 | 3 | 1 | | | 2 | | | | 4 | 60 |
| Est. 1960 ADT | 55 | 1 | 9 | 4 | 1 | | | 3 | | | | 5 | 78 |

## VEHICLES THAT WILL NOT CROSS RIVER (1960)

### INTERVIEWED AT GORE HILL STATION

| | Pass. | Light Trucks | | Medium Trucks | | Heavy Trucks | | T.T.-S.T. | | Truck-Full Tr. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Busses | Total |
| 1941 ADT Ulm leg | 79 | 8 | 22 | 7 | | | | 2 | | 5 | | | 123 |
| 1941 ADT Airport road | 25 | 2 | 3 | | | | | | | | | | 30 |
| 1941 Combined Traffic | 104 | 10 | 25 | 7 | | | | 2 | | 5 | | | 153 |
| Est. 1960 ADT that will not cross river | 135 | 13 | 33 | 9 | | | | 3 | | 6 | | | 199 |

### INTERVIEWED AT EAST STATION

| | Pass. | Light Trucks | | Medium Trucks | | Heavy Trucks | | T.T.-S.T. | | Truck-Full Tr. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Busses | Total |
| 1941 ADT | 711 | 40 | 88 | 4 | 6 | | | 4 | 4 | | | | 857 |
| Est. 1960 ADT | 924 | 52 | 115 | 5 | 8 | | | 5 | 5 | | | | 1114 |

## VEHICLES THAT WILL CROSS RIVER ON OTHER BRIDGES

### INTERVIEWED AT EAST STATION

| | Pass | Light Trucks | | Medium Trucks | | Heavy Trucks | | T.T. - S.T. | | Truck-Full Tr. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Loaded | Empty | Busses | Total |
| A.D.T. 1941 | 52 | 4 | 7 | | | | | | | | | | 63 |
| Est. A.D.T. 1960 | 68 | 5 | 9 | | | | | | | | | | 82 |

## ESTIMATED TRAFFIC FOR 1941 ON AIRPORT ROAD

The A. D. T. for 1941 on the airport road was 305 vehicles. Of these 305 vehicles, 91% of them, or 278 vehicles, used the Gore Hill - Great Falls section of US-91.

Based on the previously stated assumptions, the origin and destination breakdown of these 278 vehicles that must be added to the original sample is as follows:

| | Pass. Cars | Light Trucks Loaded | Light Trucks Empty | Total |
|---|---|---|---|---|
| 1941 A.D.T. | 250 | 14 | 14 | 278 |
| New bridge | 195 | 11 | 9 | 215 |
| 1st Ave. North Bridge | 30 | 1 | 2 | 33 |
| Didn't Cross River | 25 | 2 | 3 | 30 |
| Totals | 250 | 14 | 14 | 278 |

Here we perceive the effect of the location of the warehouse district and shopping and business area and how closely the results of the interviews are related in terms of travel intent. For example, 74% (1114/1496) of the traffic interviewed at the East Station intended a destination - or had set out from-some place east of the river; 76% (1262/1659) of the Gore Hill Traffic had origin or destination in the same area. These data support our previous assumptive statements in regard to the "drawing power" of Great Falls as a distributing and gneral business center. It is to be noted that there are few trips which contemplate no stop in the city and that benefits resulting from the construction of the 10th Avenue South Cut-off will accrue mainly to "short trip" traffic. By "short trip" traffic we mean that traffic which will have occasion to travel from the south to some place in the business area and then return; these trips are not "through" trips in that the drivers do not contemplate travel from one extreme limit of Great Falls to the other.

In addition to the traffic which might possibly be diverted to the new improvement there are other elements of traffic which enter the picture which could not be contacted in the course of the Origin-Destination Study, these being (1) the pickup to the Sun River Bridge on US-91 between the Gore Hill study point and the Sun River Bridge; (2) the traffic having origin west of Great Falls with destination east thereof; (3) the Country Club traffic and (4) intra-city, business and pleasure trips. All these elements with the exception of the West Great Falls traffic are of the "short trip" variety.

In the analysis which follows we will be treating with a volume of 2,139 vehicles per day over the length of the proposed improvement plus such

mileage as these vehicles will go on the streets of Great Falls in the course of business or pleasure driving. It is believed that the economy which supports and generates such a volume of traffic will progress to warrant the estimates set forth immediately herebefore.

## IV. ECONOMIC ANALYSIS

In this section of the report we delve into the details of costs and possible future revenues and benefits to arrive at an answer which will qualify and substantiate those statements rendered in Section I, SUMMARY OF FINDINGS.

### A. ANNUAL COST CALCULATIONS

This proposed improvement is still in the planning stage - it might better be said that it is in the "possibility" stage, hence cost data are somewhat lacking. In any event, we can estimate that the bridge structure, some 1,200 feet in length, will cost about $350 per lineal foot to render a total cost in the neighborhood of $420,000. Other auxiliary structures, some 280 feet in combined length will cost about $70,000 to build at the present going rate of $250 per lineal foot. Engineering costs to take care of detailed surveys, borings, design, layout and supervision during construction will approximate 4% of the total cost, say $17,500. Add to this a contingency item of 10%, $50,750 to arrive at a total cost of $558,250.

Other costs attaching to the construction of approaches will be as follows:

| | |
|---|---|
| Grading, Fill protection, landscaping............... | $40,000 |

In consideration of a probable high fill, average 10 feet throughout, the necessity for rip-rap along those intervals of the route which will fall into the Sun River and the Missouri River. No doubt the

civic authorities will require and request that the whole route be landscaped in line with present developments in Great Falls along Park Drive.

Gravel Base and Surface.....................$10,500

The traffic volume will require a 40' roadbed; its character, heavy hauling units, will require a substantial base, 12" or more.

Clearing and Grubbing.......................$ 1,000

Bituminous Surfacing........................$ 8,000

Traffic will require a high type pavement, penetration asphalt, at least.

Minor Drainage Structures...................$ 3,500

Engineering.................................$ 2,500

Right-of-Way................................$10,000

Sub-Total....$75,500

+ 10% for contingencies.......$ 7,550

Total estimated cost for grading, surfacing, etc.,....$83,050

Total cost of new construction would then be $641,300, ($558,250 + $83,050).

Interest changes will be assigned to the road "as built" to thus lay up a reserve to meet possible increased construction costs at some time in the future when the requirements of traffic use a ordinary wear and tear will necessitate reconstruction. In the case of the bridge and other major structures it is assumed that the economic service life will terminate in 40 years - other features of construction will last for 20 years. Two and one-half percent interest will be applied to the sum total of the construction investment to be amortized in 40 years for the bridges and 20 years for the grading, surfacing, etc., to render an annual capital charge as follows:

Bridges, other major structures, $558,250 x 0.0398 = $22,218

Grading, surfacing, etc., 83,050 x 0.0641 = 5,324

Total annual capital cost new construction = $27,542

It is assumed that $1,000 per year, say $958, will take care of the maintenance of the proposed improvement to render a total annual capital cost of $28,500, ($27,542 + $958). These data are set forth in somewhat lesser detail in the tabulation which follows:

## HIGHWAY PROJECT ANALYSIS

ANNUAL COST
CALCULATIONS

Location of project Great Falls County Cascade
Description of project Tenth Avenue South Cut-off
Highway number Highway system FA Primary
Length 1.28 Miles Date of analysis January 1946

### CAPITAL COSTS

| Item | | Net Cost | Interest Rate | Amort. Period | Annual Capital Cost |
|---|---|---|---|---|---|
| Rights of way, easements, etc. | | $ 10,000 | $ 2½% | 20 years | $ 641 |
| Clearing, grading, etc. | | 41,000 | 2½% | 20 years | 2,628 |
| Pavements and surfacing: | | | | | |
| Type Grav., Base & Surf. | Mi. | 10,500 | 2½% | 20 years | 673 |
| Type High Type Bit. | Mi. | 8,000 | 2½% | 20 years | 513 |
| Structures: | | | | | |
| Type Bridge, 1,200 | Ft. | 420,000 | 2½% | 40 years | 16,716 |
| Type OP's , 280 | Ft. | 70,000 | 2½% | 40 years | 2,786 |
| Type Minor , Drainage | Ft. | 3,500 | 2½% | 20 years | 224 |
| Engineering: | | 20,000 | 2½% | 20 + 40 yrs. | 857 |
| +10% for contingencies | | 58,300 | 2½% | 20+40 years | 2,504 |
| Unamortized cost new const. | | $641,300 | | | |
| 1. Total annual capital cost | | | | | $27,542 |

### MAINTENANCE COSTS

| | Gross Cost |
|---|---|
| 2. Total annual maintenance cost | $ 958 |
| TOTAL ANNUAL COSTS (1+2) | $28,500 |

B. AVERAGE DAILY TRAFFIC, 1960

In Section III of this report we mentioned two categories of traffic, these being that "outside" traffic which might divert to the proposed improvement and the added traffic, principally intra-city insofar as travel intent is concerned. In the discussion which follows we will classify these elements by origin-destination within and outside of the city.

I. Outside Traffic.

In the course of the Origin-Destination Study we determined the probable use of the proposed improvement by traffic having origin-destination south and east of the city but we did not determine the ultimate destination of each of the several drivers interviewed. In other words, we did not find out whether the driver would return from a destination east of the river in Great Falls or proceed on through the city - except in the case of that traffic interviewed at the East Station. Here we found a certain number of drivers who expressed the belief that they would have occasion to use the cut-off, when and if built. In respect to the city limits of Great Falls this traffic could well be labelled "through traffic" and we believe it reasonable to say that a like number of those "cutoff" drivers interviewed on Gore Hill, had they been questioned further, would have stated their destination to be east of and beyond Great Falls. In any event this number of drivers in relation to the whole of traffic on the Gore Hill approach is small and does not unduly affect the results of the analysis, while it does give us a clue to the travel intent of the Gore Hill traffic which might be diverted to the cutoff. In other words, we believe there is "through" traffic on Gore Hill which serves to reciprocate that traffic from east of Great Falls which will use the new cutoff.

In the discussion which follows each of the several traffic

categories will be set forth under a vehicle classification with a following description of the present travelled way and the probable future travelled way and the traffic volume in each instance. These details are necessary in the computation of benefits in the latter phases of this analysis.

a. Passenger Cars

(1) THROUGH GREAT FALLS, STOP - GORE HILL; 75 vehicles per day; presently via US-91 from the Sun River Bridge to the junction with Central Avenue West thence by way of the First Avenue Bridge and First Avenue North to Fourth Street, then circle the shopping district, thence north by way of Fourth Street to US 87-89, Second Avenue North, thence by way of US 87-89 to the Junction east of town with the existing Tenth Avenue South Bypass, total mileage 7.5 miles; in the future, via the proposed improvement to Fourth Street, thence by way of Fourth Street to First Avenue North, then circle the shopping area and return by way of Fourth Street to the Tenth Avenue South Bypass, thence by way of the bypass to the junction with US 87-89 east of the city, total mileage, 7.2; saving in distance, 0.3 miles.

(a) This volume of traffic represents half the so-called reciprocating traffic mentioned on page 12. Even though this traffic was tagged with a "through" label we deem it highly improbable that this traffic, particularly passenger car traffic, would proceed straight through Great Falls without stopping and making a small diversionary pass through the city business area. In regard to the routes laid out, both old and new, we say that the effect of several trips through the town would tend to localize along the lines of travel suggested to arrive at the mileages given in the summary - it is not intended to state that this traffic now uses First Avenue North, for example, in the business area nor is it probable or even mandatory that this traffic will use Fourth Street in approaching or leaving the business area in the future in a diversionary trip from or to the Tenth Avenue South Bypass and Cutoff. The lines of travel were laid out only to arrive at a general average of distance savings in regard to this particular category of traffic.

(2) GREAT FALLS - GORE HILL, THROUGH; 75 vehicles per day; presently via US-91 to the junction with Central Avenue West, thence by way of the First Avenue Bridge and First Avenue North to Fourth Street, thence by way of Fourth Street to the existing Tenth Avenue South Bypass, thence by way of the bypass, to its junction with US 87-89, total mileage, 7.1; in the future via the proposed improvement and the existing bypass, total mileage, 5.3; saving in distance, 1.8 miles.

(a) This volume of traffic represents that traffic which will proceed straight through Great Falls with no stop-overs or diversionary trips. The same comments in reference to lines of travel, old and new, set forth above hold true in this instance.

(3) GREAT FALLS - GORE HILL; 325 vehicles per day; presently via US 87-89 from Eighteenth Street to Park Drive, thence by way of Park Drive and the First Avenue Bridge to the junction with US-91, thence by way of US-91 to the Sun River Bridge approach, total mileage, 3.45; in the future, via the

proposed improvement and the existing bypass to Eighteenth Street, thence north via Eighteenth Street to the intersection with US 87-89 at Second Avenue North, total mileage 3.35; saving in distance, 0.1 miles.

(a) By reference to the tabulations in Section III of this report, we find the total passenger car volume which might be diverted to the proposed improvement to be 1,054 vehicles per day; we have accounted for 150 of these units in sub-sections (1) and (2) immediately herebefore. Now to take out the Gore Field traffic, 254 vehicles, (195 x 1.3) to arrive at a remainder of 650 vehicles per day, (1,054 - (150 + 254). To arrive at a fair and impartial end in the analysis one-half of this remainder was deemed to have origin-destination in the residential areas of the city. This "center of gravity", so to speak, was located on US 87-89 at Eighteenth Street and in effect we state that all trips from residential areas of Great Falls to the beginning of the proposed improvement near the Sun River Bridge will average out to 3.45 miles. We do not presume to say either that such traffic will follow the lines of travel set forth hereabove - here, as in subsection (1), (a), the line of "old" travel tends to localize along the described route. With regard to the "new" route, it is presumed that traffic will divert north from the bypass at any point east of Third Street to average out at Eighteenth Street so that we can arrive at a comparable basis in the determination of distance savings.

(4) GORE HILL - GREAT FALLS; 325 vehicles per day; presently via US-91 from the Sun River Bridge to the intersection with Central Avenue West, thence by way of the First Avenue Bridge and First Avenue North to Seventh Street, total mileage, 2.5; in the future, via the proposed improvement and the existing bypass to Seventh Street, thence via Seventh Street to First Avenue North, total mileage, 2.4; saving in distance, 0.1 miles.

(a) This volume represents that traffic which would have origin outside the city and destination somewhat nearer the business district - it is presumed that this traffic would have less occasion to call or go to the residential areas. Routes of travel, old and new, are laid out to arrive at a comparative basis in the computation of distances and distance savings.

(5) GREAT FALLS - GORE FIELD; 127 vehicles per day; presently, as per description of GREAT FALLS - GORE HILL traffic; route in the future, as described for the GREAT FALLS - GORE HILL traffic route.

(a) This volume is half that estimated as having origin-destination at Gore Field in 1960.

(6) GORE FIELD - GREAT FALLS; 127 vehicles per day; presently, as per description of GORE HILL - GREAT FALLS traffic route; in the future as described for GORE HILL - GREAT FALLS traffic route.

(7) GORE FIELD - GREAT FALLS, COMMERCIAL; 39 vehicles per day; presently by way of US-91 from the Sun River Bridge to Central Avenue West, thence by way of the First Avenue Bridge and First Avenue North to Fourth Street, total mileage, 2.2; in the future, via the proposed improvement and Fourth Street to First Avenue North; total mileage, 2.1, distance saving, 0.1 miles.

(a) It is thought that the 30% increase allotted the airport

traffic did not comprehend any unusual development of Gore Field. We believe that traffic having origin-destination at the airport will increase by 1960 by fully 50%. The figure 39 represents the difference between a 50% increase and a 30% increase and would be, in our estimation, indicative of taxicab traffic in the future, hence the direct routes, old and new, to the "uptown area of Great Falls.

(8) EAST GREAT FALLS -STOP & THROUGH; 75 vehicles per day;
(a) See discussion, sub-paragraph (1), (a), this sub-section.

(9) EAST GREAT FALLS - THROUGH; 75 vehicles per day;
(a) See discussion, sub-paragraph (2), (a), this sub-section.

b. Light Trucks

(1) THROUGH GREAT FALLS, STOP - GORE HILL; 27 vehicles per day; presently via US-91 from the Sun River Bridge to Central Avenue West, thence by way of the First Avenue Bridge and First Avenue North to Fourth Street, thence two blocks south to First Avenue South, thence north three blocks on Fourth Street to US 87-89, thence east and south on US 87-89 to a junction with the existing Tenth Avenue South Bypass, total mileage 7.5; in the future, via the proposed improvement to Fourth Street, thence by way of Fourth Street to First Avenue South and return to the Tenth Avenue South Bypass, thence via the bypass to the junction with US 87-89 east of the city, total mileage, 6.7; distance saving, 0.8 miles.

(a) Here, as in the discussion for passenger cars, sub-section a, (1), (a), the traffic volume represents a reciprocating element of that volume listed as intending use of the cutoff, when and if built. In the layout of routes, old and new, it is recognized here for the first time that the warehouse district would tend to "pull" the through light truck traffic to a "center of gravity" south of the business and shopping district. This tendency has the effect of increasing the travel distance over the old route while decreasing the travel ascribed to the new route.

(2) GREAT FALLS - GORE HILL, THROUGH; 27 vehicles per day; presently via US-91 to the junction with Central Avenue West, thence by way of the First Avenue North Bridge and First Avenue North to Fourth Street, thence via Fourth Street to a junction with the existing Tenth Avenue South Bypass, thence by way of the bypass to the junction with US 87-89 east of Great Falls, total mileage, 5.3; distance saving, 1.8 miles.

(a) This volume of traffic represents that element which will proceed straight through Great Falls with no stop-overs or diversionary trips. Note that the travel lines coincide with those laid out for passenger cars, sub-paragraph (2), this sub-section.

(3) GREAT FALLS - GORE HILL; 38 vehicles per day; presently via US-91 from the Sun River Bridge to Central Avenue West, thence by way of the First Avenue North Bridge and First Avenue North to Seventh Street, thence by way of Seventh Street to First Avenue South, total mileage, 2.6; in the future, via the proposed improvement to Seventh Street, thence by way of Seventh Street to First Avenue South, total mileage 2.2; distance saving, 0.4 miles.

(a) Given reciprocating traffic, 54, as set forth in the next preceding sub-sections, we have 75 vehicles left of that traffic going

through the Gore Hill Study Point which stated intent to use the new cutoff when built. This remainder is then split 50-50 between GREAT FALLS - GORE HILL traffic and GORE HILL - GREAT FALLS traffic. This particular category of traffic, having origin in Great Falls would start with a combined "pull" to the residential district and to the warehouse district insofar as the situs of origin is concerned, hence the end-point east and south two blocks on Seventh Street.

(4) GORE HILL - GREAT FALLS; 37 vehicles per day; presently, as above with the exception that the trip is terminated at Fourth Street and First Avenue South, total mileage 2.4 miles; in the future, as per above sub-section, except that the trip is terminated at Fourth Street and First Avenue South, total mileage, 2.0; distance saving, 0.4 miles.

(a) Here in consideration of the origin, outside of Great Falls and a destination probably connected with business or commerce, the trip termination was set with a "pull" to the business area and the warehouse district.

(5) GREAT FALLS - GORE FIELD; 13 vehicles per day; presently and in the the future by routes outlined in sub-section (3), set forth hereinbefore, distance saving, 0.4 miles.

(6) GORE FIELD - GREAT FALLS; 13 vehicles per day; presently and in the future by routes outlined in sub-section (4) set forth hereinbefore; distance saving, 0.4 miles.

(7) GORE FIELD - GREAT FALLS, COMMERCIAL; 4 vehicles per day; presently and in the future by routes outlined in sub-section (7) of the discussion treating with passenger cars.

(a) Traffic volume determined as per discussion in reference above.

(8) EAST GREAT FALLS - STOP & THROUGH; 27 vehicles per day;

(a) See discussion, sub-paragraph (1), this sub-section.

(9) EAST GREAT FALLS - THROUGH; See discussion, sub-paragraph (2), this sub-section.

c. Medium and Heavy Trucks and Trailer Combinations

These vehicles being generally in the business of highway transport were combined in one classification insofar as traffic volumes and routes, old and new, are concerned.

(1) GORE HILL - GREAT FALLS; 36 vehicles per day; presently via US-91 from the Sun River Bridge to Central Avenue West, thence by way of the First Avenue Bridge and First Avenue North to Fourth Street, thence on Fourth Street to Second Avenue South, total mileage, 2.4; in the future by way of the proposed improvement to Fourth Street, thence via Fourth Street to Second Avenue South, total mileage, 1.9; distance saving, 0.5 miles.

(a) These vehicles being engaged principally in the transportation of commodities, the terminal "center of gravity" was set at Second Avenue South to indicate the strong "pull" or influence of the warehouse district.

(2) THROUGH GREAT FALLS, STOP - GORE HILL; 12 vehicles per day; presently via US-91 from the Sun River Bridge to Central Avenue West, thence by way of the First Avenue North Bridge and First Avenue North to Fourth Street, thence via Fourth Street to Second Avenue South and on to the existing Tenth Avenue South Bypass, thence by way of the bypass to a junction with US 87-89, total mileage, 7.1; in the future via the proposed improvement to Fourth Street, thence by way of Fourth Street to Second Avenue South and return by way of Fourth Street to the bypass, thence to the junction with US 87-89 east of Great Falls, total mileage, 6.6; distance saving, 0.5 miles.

(3) GORE FIELD - GREAT FALLS; 4 vehicles per day; by routes old and new, described for the GORE HILL - GREAT FALLS traffic.

(a) Traffic volume represents the difference between 50% and 30% increase. See discussion, Passenger Cars, sub-section (7), (a).

(4) EAST GREAT FALLS - STOP AND THROUGH; 12 vehicles per day; by routes, old and new, described in sub-section (2) above; distance saving, 0.5 miles.

d. Busses

At the time of the November, 1945 Origin-Destination Study the issue in regard to busses was somewhat abnormal and confused by reason of the heavy bus travel to Gore Field, hence no great expansion in bus traffic was allowed for 1960 nor were many bus drivers interviewed. The fact remains, however, that the bus terminals for the common carriers (through bus traffic) are east of the river in the uptown section of Great Falls and certainly these carriers would, when the cutoff is built, avail themselves of a route free from circuitous alignment, railroad stops, and other factors which contribute to a slow-down in speed. Accordingly, in the analysis which follows bus traffic was increased to a total of twenty east and west, twice that shown in the tabulation, Section III of this report.

(1) GORE HILL, GORE FIELD - GREAT FALLS; 14 vehicles per day; presently by way of US-91 from the Sun River Bridge to Central Avenue West, thence via the First Avenue Bridge and First Avenue North to Fourth Street, total mileage, 2.2; in the future by way of the proposed improvement to Fourth

Street, thence via Fourth Street to First Avenue North, total mileage, 2.1; distance saving, 0.1 miles.

(2) EAST GREAT FALLS, STOP - THROUGH; 6 vehicles per day; presently via US 87-89 from its junction with the existing Tenth Avenue South Bypass to Fourth Street, thence by way of Fourth Street to First Avenue North, thence via First Avenue North and the First Avenue Bridge to the inter-section with US-91, thence by way of US-91 to the beginning of the proposed improvement near the Sun River Bridge, total mileage, 7.2; in the future, via the existing Tenth Avenue South Bypass to Fourth Street, thence by way of Fourth Street to First Avenue North, and return to the Bypass, thence via the proposed improvement to its beginning near the Sun River Bridge, total mileage, 7.0; distance saving, 0.2 miles.

2. Added Traffic

This category of traffic, with the exception of that designated as the PICK-UP TO SUN RIVER, is generally a token recognition of "inside" traffic which will have occasion to use the cutoff when built. The figures in all cases are very conservative and are entered in this analysis to indicate other benefit possibilities inherent in the proposed construction. To continue with the classification of traffic we submit data as follows:

a. Passenger Cars

(1) INTRA-CITY, BUSINESS, PLEASURE; 200 vehicles per day; presently from near the Sun River Bridge on US-91 to Central Avenue West, thence via the First Avenue North Bridge and First Avenue North to Fourth Street and return to the origin of the trip, total mileage, 4.4; in the future, from point near the Sun River Bridge via the proposed improvement to Fourth Street, thence by way of Fourth Street to First Avenue North and return to the point of origin of the trip, total mileage, 4.3; distance saving, 0.1 miles.

(a) It is assumed that in the future, as at present, there will be a significant volume of passenger car drivers who would have occasion to use the cutoff in recreational or diversionary driving. To arrive at a comparative basis in the calculation of distance savings it was assumed that such pleasure jaunts would in effect repeat themselves in a round trip from the Sun River Bridge to the uptown area insofar as mileage is concerned.

(2) WEST GREAT FALLS & THROUGH; 75 vehicles per day; presently from the junction of US-91 and Central Avenue West to Park Drive via the First Avenue Bridge, thence by way of Park Drive and US 87-89 to the junction with the existing Tenth Avenue South Bypass east of Great Falls, total mileage, 6.0; in the future, from Central Avenue West via US-91 to the beginning of the proposed improvement and the existing Tenth Avenue South Bypass to the junction with US 87-89 east of Great Falls, total mileage, 6.5; additive mileage, 0.5.

(a) It is assumed that some few vehicles originating west of Great Falls will have occasion to use the new cutoff at the expense of additional travel distance. Because of the avoidance of city congestion and

because of longer "high speed" zones, these drivers will profit themselves in the long run.

(3) COUNTRY CLUB - GREAT FALLS; 60 vehicles per day; presently via the entry road to a point near the Sun River Bridge, thence by way of US-91 to Central Avenue West, thence by way of the First Avenue Bridge to Park Drive, thence via Park Drive and US 87-89 to Eighteenth Street, total mileage, 3.7; in the future, via the entry road to the proposed improvement, thence by way of the cutoff and the existing Tenth Avenue South Bypass to Eighteenth Street, thence north of Eighteenth Street to the intersection with US 87-89, total mileage, 3.3; distance saving, 0.4 miles.

(a) It is assumed that this traffic would have an average origin situs similar to that laid out for the GREAT FALLS - GORE HILL passenger car traffic.

(4) PICK-UP TO SUN RIVER; 134 vehicles per day; presently from the Sun River Bridge to Central Avenue West on US-91 thence by way of the First Avenue North Bridge and the First Avenue North to Thirteenth Street, total mileage, 3.0; in the future, via the proposed improvement to Fourth Street, thence north on Fourth Street to First Avenue North and east on First Avenue North to Thirteenth Street, total mileage, 2.9; distance saving, 0.1 miles.

(a) The additive traffic represents the difference in passenger car volume between that recorded at the Sun River Bridge and that recorded at the top of Gore Hill. In locating the situs of origin-destination east of the river, due consideration was given to the relative "pull" of the residential area and the shopping and business district.

b. Light Trucks

(1) INTRA-CITY, PLEASURE, BUSINESS; 32 vehicles per day; presently and in the future by routes described in sub-section A, Passenger Cars, subparagraph (1).

(a) It is assumed that these vehicles will comprise delivery trucks and other business and commercial units in the main.

(2) WEST GREAT FALLS & THROUGH; 9 vehicles per day; presently and in the future by routes described in sub-section A, Passenger Cars, subparagraph (2).

(3) COUNTRY CLUB -GREAT FALLS; 10 vehicles per day; presently via the entry road to a point near the Sun River Bridge, thence via US-91 to Central Avenue West, thence by way of the First Avenue Bridge and First Avenue North to Fourth Street, total mileage, 2.5; in the future, via the entry road to the proposed improvement, thence to Fourth Street, thence by way of Fourth Street to First Avenue North, total mileage 2.1; distance saving, 0.4 miles.

(4) PICK-UP TO SUN RIVER; 27 vehicles per day; presently by way of US-91 to Central Avenue West thence by way of the First Avenue North Bridge and First Avenue North to Seventh Street, total mileage, 2.5; in the future via the proposed improvement and the existing Tenth Avenue Bypass to Seventh Street, thence by way of Seventh Street to First Avenue North, total mileage. 2.1; distance saving, 0.4 miles.

c. Medium and Heavy Trucks and Trailer Combinations

(1) INTRA-CITY, PLEASURE, BUSINESS; 11 vehicles per day; presently via US-91 from the Sun River Bridge to Central Avenue West, thence by way of the First Avenue Bridge and First Avenue North to Fourth Street, thence along Fourth Street to Second Avenue South, total mileage, 2.4; in the future via the proposed improvement to Fourth Street, thence along Fourth Street to Second Avenue South, total mileage, 2.1; distance saving, 0.3 miles.

(2) WEST GREAT FALLS & THROUGH; 4 vehicles per day; presently via Central Avenue West from its junction with US-91 to Fourth Street over the First Avenue Bridge and First Avenue North, thence south along Fourth Street to the bypass thence east along the bypass to the junction with US 87-89, total mileage, 5.9; in the future, via US-91 to a point on the new project, thence along the proposed improvement to Fourth Street, thence north along Fourth Street to Second Avenue South and return to the bypass, thence east along the bypass to the junction with US-87-89, total mileage, 7.7; additive distance, 1.8 miles.

(3) PICK-UP TO SUN RIVER; 9 vehicles per day; by routes, old and new, as described for INTRA-CITY, PLEASURE, BUSINESS traffic in sub-paragraph (1) hereinbefore.

d. Busses

Comprising school busses, intra-city transit busses and others.

(1) INTRA-CITY, PLEASURE, BUSINESS; 20 vehicles per day; old route from a point near the Sun River Bridge to the intersection of Fourth Street and First Avenue, 2.2 miles; new route, 2.1 miles; distance saving, 0.1 miles.

(2) WEST GREAT FALLS & THROUGH; 2 vehicles per day; by routes, old and new, described in sub-section a, Passenger Cars, sub-paragraph (2); additive mileage, 0.5.

(3) PICK-UP TO SUN RIVER; 6 vehicles per day; by routes, old and new, as described for INTRA-CITY, PLEASURE, BUSINESS busses hereinbefore.

3. Traffic Summary, 1960

The various elements of traffic which, it is presumed, will use the new cutoff, have been set forth in considerable detail as a preliminary to the computation of benefits in the latter phases of this report. Summarizing and consolidating we have results as shown on the tabulation which follows:

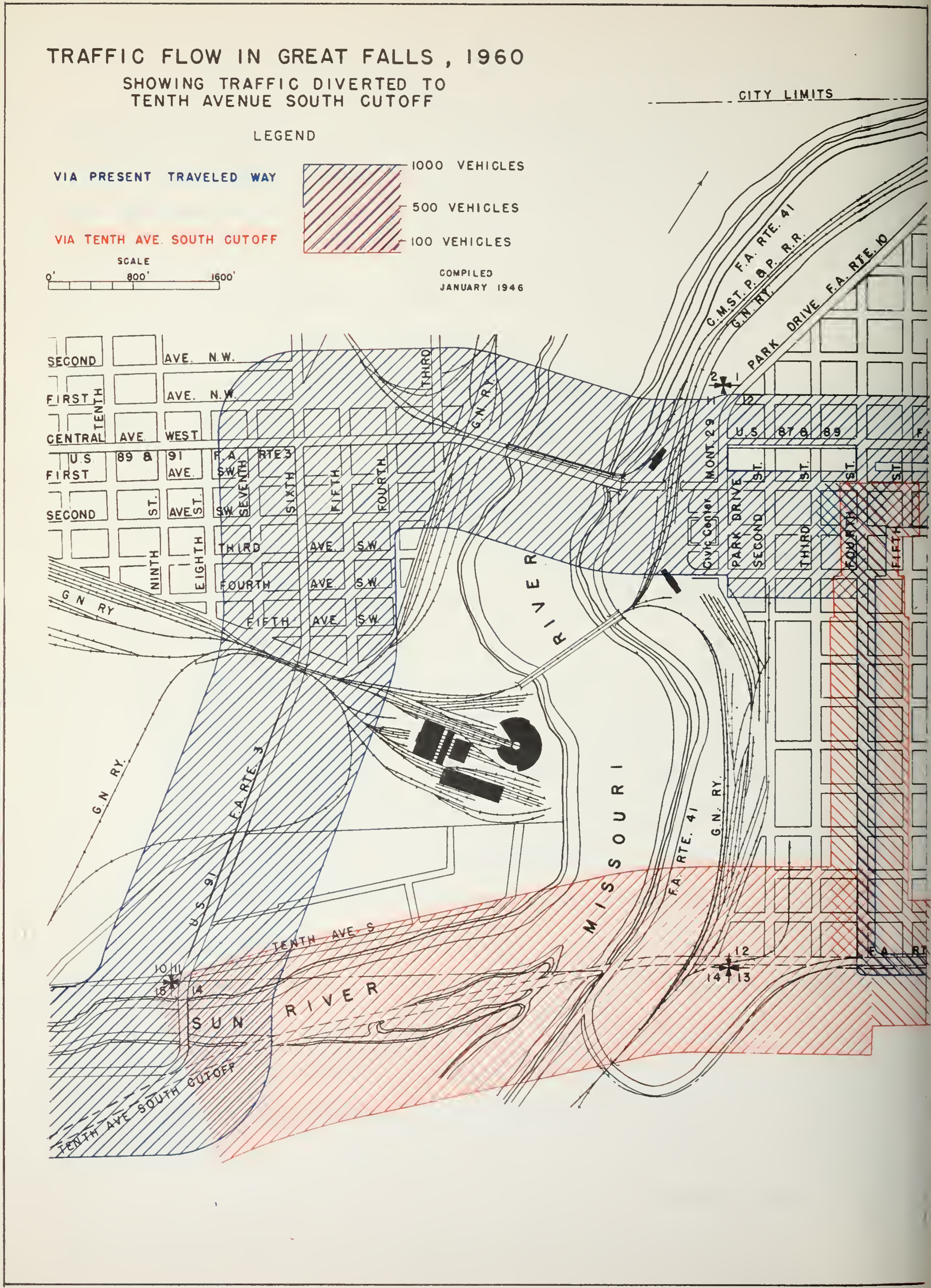
### ESTIMATED DAILY TRAFFIC VOLUME OVER 10th AVENUE SOUTH CUT-OFF, 1960

| Traffic Categories | Travel Distance Miles Old | Travel Distance Miles New | Passenger Cars | Light Trucks | Medium Trucks | Heavy Trucks | Trac. Tk. & Semi-Trailers | Tk. & Trailer Combinations | Busses | All Trucks & Busses | All Traffic |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Outside Traffic | | | | | | | | | | | |
| | 4.00 | 3.65 | 1243 | | | | | | | | |
| | 4.95 | 4.10 | | 213 | | | | | | | |
| | 2.40 | 1.90 | | | 14 | | | | | | |
| | 2.40 | 1.90 | | | | 8 | | | | | |
| | 5.70 | 5.20 | | | | | 34 | | | | |
| | 2.40 | 1.90 | | | | | | 8 | | | |
| | 3.70 | 3.55 | | | | | | | 20 | | |
| Trucks & Busses | 4.70 | 3.95 | | | | | | | | 297 | |
| Composite | 4.15 | 3.70 | | | | | | | | | 1,540 |
| Inside Traffic | 4.15 | 4.10 | 469 | | | | | | | | |
| | 3.70 | 3.50 | | 78 | | | | | | | |
| | 2.90 | 2.75 | | | 7 | | | | | | |
| | 2.65 | 2.35 | | | | 6.5 | | | | | |
| | 3.10 | 3.05 | | | | | 7.5 | | | | |
| | 3.55 | 3.80 | | | | | | 3 | | | |
| | 2.45 | 2.40 | | | | | | | 28 | | |
| Trucks & Busses | 3.35 | 3.15 | | | | | | | | 130 | |
| Composite | 3.95 | 3.90 | | | | | | | | | 599 |
| All Traffic | 4.10 | 3.75 | 1712 | 291 | 21 | 14.5 | 41.5 | 11 | 48 | 427 | 2,139 |

These data as regards traffic volume and travel routes, old and new, are set forth graphically on pages 22 a and 23. When reading the chart it is to be remembered that travel routes are laid out as per the detailed descriptions which preceded this presentation and that traffic bands apply only to traffic which will use the cutoff. West of the Missouri River, the traffic flow, old and new, as depicted, is generally correct - east of the river the chart shows the flow tendency as determined in this office and as described in detail heretofore. A proper indication of the old lines of travel would show a gradual build-up of traffic from the east residential district, then a faster development through the business area, culminating in the present congestion at the east approach to the First Avenue Bridge. By the same token, traffic taking off from or feeding to the Tenth Avenue South Bypass along the "new" route would be shown dispersed in smaller increments of traffic volume along the north-south streets from Third Street east and through the residential area instead of, as shown on the chart, being grouped along Fourth, Seventh and Eighteenth Streets. In spite of the obvious deficiencies of the chart insofar as travel routes are concerned, it does show the favorable future effect of the proposed construction - about 20% of the traffic now using the First Avenue North Bridge will be shunted to new lines of traffic flow, thereby avoiding cross-town traffic "friction". The elimination or decrease in this "friction" will be a direct benefit to the traffic so dispersed along the new lines of travel - that traffic remaining on or over the bridge will be benefited indirectly by a lessening of the congestion at the east approaches to the bridge and to a lesser degree in the business and warehouse district.

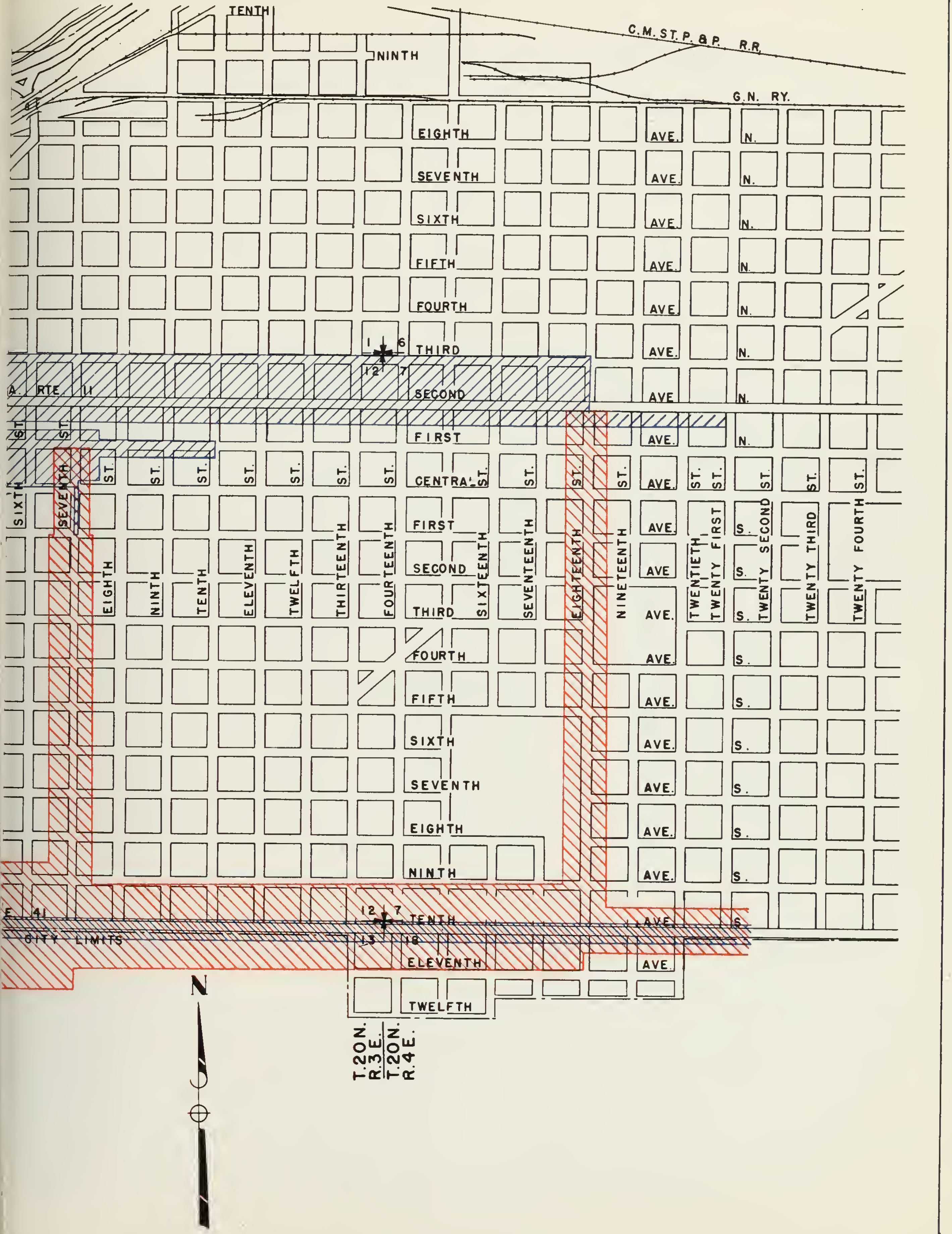
## C. ANNUAL REVENUES

Next to find the annual earnings of the proposed improvement in



TRAFFIC FLOW IN GREAT FALLS, 1960

SHOWING TRAFFIC DIVERTED TO TENTH AVENUE SOUTH CUTOFF


C.M. ST. P. & P. R.R.
G.N. RY.
TENTH
NINTH
EIGHTH AVE. N.
SEVENTH AVE. N.
SIXTH AVE. N.
FIFTH AVE. N.
FOURTH AVE. N.
THIRD AVE. N.
SECOND AVE. N.
FIRST AVE. N.
CENTRAL AVE.
FIRST AVE. S.
SECOND AVE. S.
THIRD AVE. S.
FOURTH AVE. S.
FIFTH AVE. S.
SIXTH AVE. S.
SEVENTH AVE. S.
EIGHTH AVE. S.
NINTH AVE. S.
TENTH AVE. S.
ELEVENTH AVE.
TWELFTH
RTE. 11
41
CITY LIMITS
SIXTH ST.
SEVENTH ST.
EIGHTH ST.
NINTH ST.
TENTH ST.
ELEVENTH ST.
TWELFTH ST.
THIRTEENTH ST.
FOURTEENTH ST.
SIXTEENTH ST.
SEVENTEENTH ST.
EIGHTEENTH ST.
NINETEENTH ST.
TWENTIETH ST.
TWENTY FIRST ST.
TWENTY SECOND ST.
TWENTY THIRD ST.
TWENTY FOURTH ST.
1
6
12
7
12
7
13
18
T.20N. R.3E.
T.20N. R.4E.
N

terms of gas tax revenues in 1960 - surprisingly, the resultant anticipated income is a modest sum when set up alongside our annual cost data. Obviously, if this project is to qualify for construction, it must do so on the basis of benefits alone - these data will be set forth in the next following phases of this report.

To arrive at an estimate of annual revonues the traffic data presented previously were resolved into annual vehicles and then into ton miles. These data were then extended on the basis of unit net revenues per ton mile to arrive at an estimate of the total annual income. Unit net revenues derive from a general study conducted by this department. Average gross ton figures for each class of vehicle were also ascertained in the course of research work of the Planning Survey. Traffic income is shown on the following page:

# HIGHWAY PROJECT ANALYSIS

Traffic Income

Location of project Great Falls Description of project 10th Ave. S. Bypass County Cascade
Highway Highway System FA Primary Length 1.3 miles Date of analysis January 1946

| Traffic Type | Average Annual Traffic Outside Traffic 1/Vehicles | Average Annual Traffic Outside Traffic 2/ Ton Miles | Average Annual Traffic Inside Traffic Vehicles 1/ | Average Annual Traffic Inside Traffic 2/ Ton Miles | 3/ Average Annual Road Use During Life of Project in ton miles | Unit Net Revenues Per Ton Mile | Total Annual Net Revenue |
|---|---|---|---|---|---|---|---|
| Passenger Cars - Montana | 387,995 | 756,590 | 150,380 | 293,241 | 1,049,831 | 0.002188 | $2,297 |
| Passenger Cars - Foreign | 65,700 | 128,115 | 19,345 | 37,723 | 165,838 | 0.001799 | 298 |
| Total passenger cars | 453,695 | 884,705 | 169,725 | 330,964 | 1,215,669 | | $2,595 |
| Trucks, light | 77,745 | 330,494 | 27,740 | 117,923 | 448,417 | 0.003248 | 1,456 |
| Trucks, medium | 5,110 | 45,704 | 2,555 | 22,852 | 68,556 | 0.002382 | 163 |
| Trucks, heavy | 2,920 | 42,325 | 2,373 | 34,397 | 76,722 | 0.001619 | 124 |
| Trucks, semi-trailer | 12,410 | 238,123 | 2,737 | 52,518 | 290,641 | 0.001543 | 448 |
| Trucks, full-trailer | 2,920 | 86,890 | 1,095 | 32,584 | 119,474 | 0.001396 | 167 |
| Busses | 7,300 | 85,410 | 10,220 | 119,574 | 204,984 | 0.001873 | 384 |
| Total trucks & busses | 108,405 | 828,946 | 46,720 | 379,848 | 1,208,794 | | $2,742 |
| Total all vehicles | 562,100 | 1,713,651 | 216,445 | 710,812 | 2,424,463 | | $5,337 |

Average weight of trucks 5.994 tons; All vehicles 2.395 tons. Total Annual Income...... $5,337

Percentage truck traffic 155,125/778,545 = 19.92% .

Amortization period 20 years general 40 years, bridges .

1/ Average daily traffic as set forth in the preceding section multiplied by 365. This holds true for all categories of traffic with the exception of the COUNTRY CLUB vehicles - in this particular instance these vehicles are effective over 1.2 miles of the proposed improvement. The net effect of this traffic is then 64 vehicles over the total length, $\frac{(70 \times 1.2)}{1.3}$.

2/, Column 1/, in each case, multiplied by average gross weights times the length of the proposed improvement in miles. Average gross weights are set forth herebelow:

| | | | |
|---|---|---|---|
| Passenger Cars | at 1.5 tons | Trucks & Semi-trailers at | 14.76 tons |
| Trucks, Light | at 3.27 tons | Trucks & Full trailers at | 22.89 tons |
| Trucks, Medium | at 6.88 tons | Busses at | 9.00 tons |
| Trucks, Heavy | at 11.15 tons | | |

3/ Column 2/ added together.

D. TIME ELEMENT SAVINGS

Here is the source of the major benefits that will recommend and qualify the Tenth Avenue South Cutoff for construction from an economic standpoint. The effect of this construction will allow the using traffic to travel at a higher speed over a longer interval of space in any trip, from, to or through Great Falls to save time and thereby, money. All drivers, whether they be pleasure bent or on business, can place a monetary value on their time. The tabulation which follows is based on time values deriving from studies conducted by the Oregon Highway Department in the preparation of its Technical Bulletin, No. 7. These rates, in the light of present day living, are truly conservative, and the resultant total time element saving as listed cannot, under any circumstance, be considered a fanciful figure - the value will be concrete, tangible and immediately perceptible on completion of the project.

Time Element Savings

## HIGHWAY PROJECT ANALYSIS

Location of project Great Falls County Cascade
Description of project Tenth Avenue South Cutoff
Highway number Highway System FA Primary
Length 1.3 miles Date of analysis January 1946

|  | Outside Traffic New | Outside Traffic Old | Inside Traffic New | Inside Traffic Old |
|---|---|---|---|---|
| Annual Traffic Volume |  |  |  |  |
| Private Passenger Cars (per year) | 453,695 |  | 171,185 |  |
| Trucks, light (per year)......... | 77,745 |  | 28,470 |  |
| Trucks, medium (per year)........ | 5,110 |  | 2,555 |  |
| 1/ Trucks, heavy per year)....... | 25,550 |  | 16,425 |  |
| Totals................ | 562,100 |  | 218,635 |  |
| Private Passenger Cars |  |  |  |  |
| 2/ Average speed (miles per hour) | 22.67 | 16.98 | 23.36 | 16.02 |
| 3/ Distance (Miles).............. | 3.65 | 4.00 | 4.10 | 4.15 |
| 4/ Time (hours per trip)......... | 0.161 | 0.231 | 0.1755 | 0.259 |
| 5/ Time savings per vehicle...... | 0.070 |  | 0.0835 |  |
| 6/ Value of savings ($/vehicle-hour) | $0.60 |  | 0.60 |  |
| Annual traffic volume......... | 453,695 |  | 171,185 |  |
| 7/ Totals................ | $ 19,055 |  | $8,576 |  |
| Trucks, Light |  |  |  |  |
| 2/ Average speed (miles per hour) | 24.19 | 17.69 | 23.03 | 16.61 |
| 3/ Distance (miles)............. | 4.10 | 4.95 | 3.5 | 3.7 |
| 4/ Time (hours per trip)......... | 0.1695 | 0.2798 | 0.152 | 0.228 |
| 5/ Time savings per vehicle....... | 0.1103 |  | 0.076 |  |
| 6/ Value of savings ($/vehicle-hour) | $0.86 |  | $0.86 |  |
| Annual traffic volume......... | 77,745 |  | 28,470 |  |
| Totals................. | $ 7,375 |  | $1,861 |  |
| Trucks, Medium |  |  |  |  |
| 2/ Average speed (miles per hour) | 22.09 | 13.64 | 22.45 | 14.50 |
| 3/ Distance (miles).............. | 1.90 | 2.40 | 2.75 | 2.9 |
| 4/ Time (hours per trip)......... | 0.086 | 0.176 | 0.1225 | 0.200 |
| 5/ Time savings per vehicle...... | 0.090 |  | 0.0775 |  |
| 6/ Value of savings ($/vehicle-hour) | $1.17 |  | $1.17 |  |
| Annual traffic volume......... | 5,110 |  | 2,555 |  |
| Totals................. | $ 538 |  | $232 |  |
| Trucks, Heavy |  |  |  |  |
| 2/ Average speed (miles per hour) | 20.42 | 16.39 | 18.97 | 14.53 |
| 3/ Distance (miles).............. | 3.98 | 4.38 | 2.59 | 2.66 |
| 4/ Time (hours per trip)......... | 0.1949 | 0.2673 | 0.1365 | 0.183 |
| 5/ Time savings per vehicle...... | 0.0724 |  | 0.0465 |  |
| 6/ Value of savings ($/vehicle-hour) | $1.47 |  | $1.47 |  |
| Annual traffic volume........ | 25,550 |  | 16,425 |  |
| Totals................. | 2,719 |  | $1,123 |  |
| Total each category.......... | $ 29,687 |  | $11,792 |  |
| TOTAL ANNUAL TIME ELEMENT SAVINGS.................... |  | $41,479 |  |  |

1/ Busses and trailer combinations included with "Trucks, heavy (per year)".

2/ Average speed determined, in this instance and for other types of vehicles. by dividing the distance in miles by the total time consumed for each trip classified by traffic category.

3/ Distance determined by computing mileage along lines of travel set forth in sub-section B,1, "Outside Traffic" and 2, "Inside Traffic", leading up to the presentation of the Flow Chart and shown on the tabulation, "ESTIMATED DAILY TRAFFIC VOLUME OVER THE 10th AVENUE SOUTH CUTOFF, 1960", page 21.

4/ Time, (hours per trip), computed with due consideration for mileage, rural and urban, the latter being subdivided into 20 mile speed zones and 30 mile speed zones and such other speed limiting controls (signs, railroad crossings and traffic) as now exists or will exist in the future. It was assumed that in the aggregate, traffic in large volume along restricted ways will attain to but 75% of the posted speed limit, this being the primary effect of traffic friction as brought out heretofore. "Old" speeds along the routes previously described are set forth as follows; these data are based on a survey recently made along the traffic flow lines in Great Falls. So called "rural" speeds are set in accord with data originating in the Oregon Technical Bulletin.

US-91, from a point near the Sun River Bridge to the City Limits, 0.23 miles - US 87-89 from 32nd Street in Great Falls east to a junction with the existing Tenth Avenue South Bypass, 2.64 miles - Tenth Avenue South Bypass from 32nd Street east to a junction with US 87-89, 1.74 miles - Country Club Approach Road, 0.25 miles - all "rural"; passenger car Speed 43 m.p.h. - light trucks, 39 m.p.h. - medium trucks, 35 m.p.h. - heavy trucks, 32 m.p.h.

US-91 from the city Limits north to Central Avenue West, 0.99 miles - US 87-89 east from Eighteenth Street to 32nd Street, 1.14 miles - the existing Tenth Avenue South Bypass from the end of the proposed improvement near Fourth Street to 32nd Street, 2.28 miles - all "urban" in 30 m.p.h. speed zones, effective speed, all types of vehicles, 22.5 m.p.h.

All other streets and avenues involved in the detailed descriptions - all "urban" in 20 m.p.h. speed zones, effective speed, all types of vehicles, 15 m.p.h.

When and if the cutoff is built, there will be 1.28 miles of "rural" driving added to those described immediately hereabove plus 0.03 miles of urban driving at an effective speed of 22.5 m.p.h.

The over-all effect of such speed zoning in terms of travel distance for all traffic involved in this analysis is as follows:

OUTSIDE TRAFFIC

| Vehicle Type | ADT 1960 | Urban Mileage |  |  |  | Rural Mileage |  |
|---|---|---|---|---|---|---|---|
|  |  | 15 m.p.h. |  | 22.5 m.p.h. |  | 32-43 m.p.h. |  |
|  |  | Old | New | Old | New | Old | New |
| Passenger Cars | 1,243 | 1.87 | 0.87 | 1.37 | 1.09 | 0.76 | 1.69 |
| Light Trucks | 213 | 1.74 | 0.69 | 1.87 | 1.25 | 1.34 | 2.16 |
| Medium Trucks | 14 | 1.20 | 0.59 | 0.98 | 0.03 | 0.22 | 1.28 |
| Heavy Trucks | 70 | 1.48 | 0.96 | 1.87 | 0.97 | 1.05 | 2.07 |
| All Traffic | 1,540 | 1.83 | 0.85 | 1.47 | 1.09 | 0.85 | 1.76 |

INSIDE TRAFFIC

| Vehicle Type | ADT | Urban Mileage | | | | Rural Mileage | |
|---|---|---|---|---|---|---|---|
| | | 15 m.p.h. | | 22.5 m.p.h. | | 32-43 m.p.h. | |
| | 1960 | Old | New | Old | New | Old | New |
| Passenger Cars | 469 | 2.05 | 1.06 | 1.42 | 0.91 | 0.68 | 2.13 |
| Light Trucks | 78 | 1.66 | 0.97 | 1.41 | 0.51 | 0.63 | 2.02 |
| Medium Trucks | 7 | 1.30 | 0.71 | 1.15 | 0.49 | 0.45 | 1.55 |
| Heavy Trucks | 45 | 1.18 | 0.75 | 1.08 | 0.40 | 0.44 | 1.50 |
| All Traffic | 599 | 1.92 | 1.03 | 1.39 | 0.82 | 0.64 | 2.05 |

In the case of the OUTSIDE TRAFFIC, the 15 m.p.h. zone will be decreased by about one mile, the 22.5 m.p.h. zone will be decreased by about 0.4 miles, and the RURAL mileage will be increased by 0.9 miles, all of which factors will operate to decrease the time consumed in travelling through Great Falls by way of the proposed cutoff.

In addition to the slowing effect of speed zones various traffic control devices, signs, lights, etc., operate to restrict traffic speed. It was deduced, as of the present from recent survey data, that most traffic involved in this analysis will stop for "STOP" signs, railroad crossings, and bus loading zones about four times on an average trip and it will be stopped about one plus times by traffic signal lights in the course of a trip through town. The new construction, as proposed, will serve to halve the stops for "STOP" signs; it will reduce the "SLOWS" by 75% and eliminate 80% of the stops for the traffic signal lights. All the "stops" and "slows" involve time - for purposes of this analysis it was assumed that each "stop" meant a time loss of 30 seconds and a slow down a time loss of 15 seconds. The time involved in these "stops" and "slows" was added to the computed running time for each trip to arrive at a figure that is generally reasonable and indicative of actualities in the case of present travel and probabilities in the case of future traffic.

We have no time-distance studies to support the above contention, the computed average speeds in the tabulation reflect a generally conservative rate in both cases, "old" and "new". Note the "old" speed for passenger cars, 16.98 m.p.h. - this appears to be reasonable enough when we consider that most of these trips involved passage through the congested area at the east approach to the First Avenue Bridge; the "new" speed for passenger cars will be some 5½ m.p.h. in excess of the "old" rate to effect a time saving of but 4.2 minutes per trip on the average for all passenger car traffic which will have occasion to use the cutoff. The point we are making is that it is reasonable to expect greater time savings for each type vehicle than that computed and shown on the tabulation.

5/ Subtract the "Time (hours per trip)" new from the "Time (hours per trip)" old.

6/ Value of savings ($/vehicle hour) from the Oregon Technical Bulletin.

## E. MILEAGE ELEMENT SAVINGS

These savings will accrue to the using traffic by virtue of a decrease in travel distance, improvement in alignment (the elimination of right-angle turns), and the elimination of traffic stops. These improvements operate to decrease "wear and tear;" they make a gallon of gas stretch farther. The estimated savings are tabulated hereinafter.

Mileage Element Savings

### HIGHWAY PROJECT ANALYSIS

Location of project Great Falls County Cascade
Description of Project Tenth Avenue South Cut-off
Highway number. Highway System FA Primary
Length 1.3 miles Date of Analysis January 1946

| | Outside Traffic | | Inside Traffic | |
|---|---|---|---|---|
| | New | Old | New | Old |
| Distance | | | | |
| Length (miles)..1/..2/............. | 3.70 | 4.15 | 3.90 | 3.95 |
| Distance saving (miles)........... | 0.45 | | 0.05 | |
| Average Annual traffic (tons) 3/4/ | 1,318,195 | | 551.320 | |
| Annual traffic saving (ton-mi.)5/6/ | 593,188 | | 27,566 | |
| Cost ($/ton-mile) 7/, 8/.......... | $0.0194 | | $0.0192 | |
| Annual saving...................... | | | | |
| Total........................ | $ 11,508 | | $529 | |
| Alignment | | | | |
| Curvature rating 9/, 10/.......... | 1.45 | 4.35 | 1.4 | 3.2 |
| Points improvement................ | 2.90 | | 1.8 | |
| Saving (point-ton-miles).......... | 15,864,477 | | 3,919.865 | |
| Saving ($/point-ton-mile)......... | 0.0001 | | 0.0001 | |
| Annual saving..................... | | | | |
| Total................... | $1586 | | $392 | |
| Traffic Stops | | | | |
| Number per year 4/, 5/............ | 610,780 | 1,226,670 | 219,725 | 408,430 |
| Eliminated per year............... | 615,890 | | 188,705 | |
| Aver. vehicular weight (tons)..... | 2.345 | | 2.522 | |
| Saving ($ per ton-per stop)....... | $0.00126 | | $0.00126 | |
| Annual saving..................... | $1820 | | $600 | |
| Total.................. | $14,914 | | $1521 | |

TOTAL ANNUAL MILEAGE ELEMENT SAVINGS.............$ 16,435

1/and 2/, being a composite figure involving travel distance for all types of vehicle, "old" and "new" which will have occasion to use the new cut-off in the future.

3/, OUTSIDE TRAFFIC, annual traffic tons is computed as follows:

Passenger cars 453,695 x 1.5 = 680,543
Light Trucks, 77,745 x 3.27 = 254,226
Medium Trucks 5,110 x 6.88 = 35,157
Heavy Trucks 2,920 x 11.15 = 32,558
Trac. Tk. - Semi. Trlrs. 12,410 x 14.76 = 183,172
Tks. & Full Trlrs. 2,920 x 22.89 = 66,839
Busses 7,300 x 9.00 = 65,700
Total Annual Tons...... 1,318,195

4/, INSIDE TRAFFIC, annual traffic tons as per the following:

Passenger Cars, 171,185 x 1.5 = 256,777
Light Trucks, 28,470 x 3.27 = 93,097
Medium Trucks 2,555 x 6.88 = 17,544
Heavy Trucks 2,373 x 11.15 = 26,459
Trac. Tks. - Semi trlrs. 2,727 x 14.76 = 40,398
Tks. & Full trlrs. 1,095 x 22.89 = 25,065
Busses 10,220 x 9.00 = 91,980
Total Annual Tons..... 551,320

5/and 6/ Average annual traffic (tons) times the distance saving in each instance.

7/ Distance saved cuts down the over-all operating cost: Technical Bulletin No. 7, Oregon Highway Department lists certain operating costs per ton-mile for each of the several vehicle types and offers diagram which allow one to arrive at a composite ton-mile cost when the average gross weight of the truck traffic is known. Average gross weight which might be diverted to the proposed improvement is as follows;

$$\frac{\text{Annual traffic, trucks (tons)}}{\text{Annual traffic, trucks}} = \frac{637,652}{108,405} = 5.882 \text{ tons} = 11,764 \text{ lbs.}$$

The proportion of truck traffic to the whole is as follows;

$$\frac{\text{Ave. Annual Traffic, trucks}}{\text{Ave. Annual Traffic, all vehicle}} = \frac{108,405}{562,100} = 19.3\%$$

By reference to Figure 113 of the Technical Bulletin it is found that the operating cost per ton-mile of truck traffic in the weight class cited hereabove is $0.0142; the operating cost for passenger car ton-mile is listed at $0.0207. Combining these costs in the proportions manifest we have a composite cost as follows;

Trucks, (19.3%) 0.193 x $0.0142 = $0.0027
Passenger Cars, (80.7%) 0.807 x $0.0207 = $0.0167
Combined operating cost per ton-mile..... $0.0194

8/ INSIDE TRAFFIC

Average gross weight tons

$$\frac{\text{Annual Traffic, Trucks (tons)}}{\text{Annual Traffic, Trucks}} = \frac{294,543}{47,450} = 6.207 \text{ tons} = 12,414 \text{ lbs.}$$

Proportion trucks to all vehicles.

$$\frac{\text{Annual Traffic, Trucks}}{\text{Annual Traffic, all vehicles}} = \frac{47,450}{218,635} = 21.7\%$$

Operating cost trucks @ 12,414 lbs. = $0.0137 per ton-mile.
Operating cost passenger cars = $0.0207 per ton-mile.
Trucks (21.7%) 0.217 x $0.0137 = $0.0030
Passenger Cars (78.3%) 0.783 x $0.0207 = $0.0162
$0.0192

9/ By observation of the previously described lines of travel it was found that the traffic involved in this analysis makes right-angle turns on entering or leaving Great Falls as set forth herebelow; the proposed improvement will operate to eliminate many of these turns to thus affect an improvement in alignment.

OUTSIDE TRAFFIC

| VEHICLE TYPE | ADT | Right-angle turns | | SAVING |
|---|---|---|---|---|
| | | OLD | NEW | |
| Passenger cars | 1243 | 4.5 | 1.5 | 3.0 |
| Light Trucks | 213 | 3.8 | 1.3 | 2.5 |
| Medium Trucks | 14 | 3.0 | 1.0 | 2.0 |
| Heavy Trucks | 8 | 3.0 | 1.0 | 2.0 |
| Trac. Tks. & Semi. Trlrs. | 34 | 3.7 | 1.2 | 2.5 |
| Trucks & Full-Trlrs. | 8 | 2.0 | 1.0 | 2.0 |
| Busses | 20 | 2.9 | 1.6 | 1.3 |
| All Traffic | 1540 | 4.35 | 1.45 | 2.9 |

The saving was considered as a measure of the alignment point-improvement.

10/ INSIDE TRAFFIC, Curvature rating and points improvement.

| VEHICLE TYPE | ADT | Right-angle turns | | SAVING |
|---|---|---|---|---|
| | | OLD | NEW | |
| Passenger cars | 469 | 3.2 | 1.4 | 1.8 |
| Light Trucks | 78 | 3.1 | 1.4 | 1.7 |
| Medium Trucks | 7 | 3.1 | 1.3 | 1.8 |
| Heavy Trucks | 6.5 | 3.1 | 1.1 | 2.0 |
| Trac. Tks. & Semi-Trlrs. | 7.5 | 3.2 | 1.4 | 1.8 |
| Tks. & Full Trailers | 3 | 3.3 | 1.7 | 1.6 |
| Busses | 28 | 3.1 | 1.2 | 1.9 |
| All Traffic | 599 | 3.2 | 1.4 | 1.8 |

11/and 12/, The average annual traffic, tons, times the "old" distance, times the points improvement in each case.

13/ Rates in both cases ascertained in course of studies conducted by the Oregon Highway Department.

14/and 15/ Basic data deriving from a recent log of "STOP" signs. The "stops" are allocated, old and new with due consideration for the previously described traffic flow lines.

16/ Rates in both instances ascertained in course of research by the Oregon Highway Department.

## F. TRAFFIC BENEFITS

This tabulation involves an allocation of benefits, fuel functions and non-fuel functions, in accord with the proportions advanced by the Oregon Highway Department.

Traffic Benefits

### HIGHWAY PROJECT ANALYSIS

| | | | |
|---|---|---|---|
| Location of project | Great Falls | County | Cascade |
| Description of project | Tenth Avenue South Cutoff | | |
| Highway number | | Highway system | FA Primary |
| Length | 1.3 miles | Date of analysis | January 1946 |

Mileage Element Factors

| Item | | Fuel Function | | | |
|---|---|---|---|---|---|
| Distance savings | $12,037 | $ 38% | 4,574 | $ 62% | $7,463 |
| Alignment savings | 1,978 | 50% | 989 | 50% | 989 |
| Elimination of traffic stops | $2,420 | 50% | 1,210 | 50% | 1,210 |
| Total Mileage Savings | $16,435 | $ | 6,773 | $ | 9,662 |

Time Element Factors

| Type of Traffic | Annual Value of Time Savings |
|---|---|
| Passenger Cars | $ 27,631 |
| Trucks, light | $ 9,236 |
| Trucks, medium | $ 770 |
| Trucks, heavy | $ 3,842 |
| Total Time Savings | $ 41,479 |

Recapitulation of Annual Benefits

| | | |
|---|---|---|
| Total Fuel Function Benefits | | $ 6,773 |
| Non-fuel function benefits (Mileage element factors | $ 9,662 | |
| (Time element factors | 41,479 | |
| Total Non-fuel Function Benefits | | $ 51,141 |
| TOTAL ANNUAL BENEFITS | | 57,914 |

## G. DERIVATION OF QUOTIENTS

Now to marshal such factual data as we have assembled heretofore

and derive quotients which are indicative of the feasibility and desireability of constructing the proposed cut-off.

HIGHWAY PROJECT ANALYSIS

Location of project Great Falls County Cascade
Description of Project Tenth Avenue South Cut-Off
Highway number Highway system FA Primary
Length 1.28 Miles Date of analysis January 1946

$Iar = \$\ 5,337$ 1/ $K_1 = 1.00$

$C_a = \$\ 28,500$ 2/ $K_2 = 1.00$

$B_n = \$\ 51,141$ 3/ $K_3 = 0.05/0.20 = 0.25$

$B_f = \$\ 6,773$ $K_2K_3 = 1.00 \times 0.25 = 0.25$

$K_1C_a = \$\ 28,500$ $1-K_2K_3 = 1.00 - 0.25 = 0.75$

4/ $Q_s = Iar/K_1C_a = 5,337/28,500 = 0.19$

5/ $Q_{Bn} = B_n/K_1C_a = 51,141/28,500 = 1.79$

6/ $Q_{Bf} = B_f/K_1C_a = 6,773/28,500 = 0.24$

7/ $Q'_s = Q_s - K_2K_3Q_{Bf} = 0.19 - 0.25 \times 0.24 = 0.19 - 0.06 = 0.13$

$$
\begin{aligned}
Qc = 0.707\ (Q_s + Q_{Bn} + Q_{Bf}(1-K_2K_3) &= 0.707\ (0.19 + 1.79 + 0.24 \times 0.75) \\
&= 0.707\ (0.19 + 1.79 + 0.18) \\
&= 0.707 \times 2.16 \\
&= 1.53
\end{aligned}
$$

1/ Being the pro rata cost chargeable to Road User Funds, the gasoline License Tax Levy in this case.

2/ The constant $K_2$ represents the proportion of the total fuel savings which derives from traffic, diverted to the proposed improvement. In this case all of the traffic which will use the cut-off will have been diverted from existing main highways.

3/ The constant $K_3$ represents the ratio of fuel cost to the total cost of fuel.

4/ The solvency quotient, $Q_s$, shows that the project when built will earn but 19% of its cost. Most projects, when programmed and when analyzed from an economic standpoint, will show an "earning" capacity in excess of 40%. This proposal fails of achieving a high earning rate by reason of the heavy

expenditures attaching to the bridge construction.

5/ The quotient $Q_{B_n}$ shows the favorable effect of the time element savings. As a matter of note, these benefits alone would qualify the project for improvement.

6/ The quotient $Q_{Bf}$ indicates the relationship between the annual fuel savings and the annual capital costs. As will be noted this quotient is almost as low as the solvency quotient.

7/ The quotient $Q'_s$ represents the corrected solvency quotient. The immediate effect of diverting the traffic to the proposed cut-off will be to decrease revenues on US 91, 87-89 and other main routes in the amount of 25% of the total fuel savings, $6,773.

8/ The quotient $Q_c$ represents the composite quotient of the proposed improvement when income and benefits in relation to costs are taken into consideration. It is the true measure of the worth of any proposed project. In this case, the composite quotient being 1.53, the cut-off is indeed a desireable and feasible project for improvement from an economic standpoint. It is feasible but not truly necessary to build a public improvement when the composite quotient is unity --- such a condition, generally speaking, would indicate a situation where benefits would equal anticipated revenues. In other words the benefits would operate to pay the fuel tax in which case existing facilities would serve adequately. Here the "pull" for construction of the cut-off stands in the ratio 3 to 2 to indicate the desireability of the proposed improvement.

## V RECOMMENDATIONS

It is recommended that further study of traffic flow in the city of Great Falls be effected with a view to relieving congestion at the east approaches of the First Avenue North Bridge by other improvements at lesser cost than that contemplated in the construction of the cut-off. This recommendation does not reflect adversely on the meaning and significance of the solvency quotient as established in this analysis; it is feared, however, that such a large expenditure of highway funds in one spot would prejudice the interests of other resident road users in areas contiguous to and feeding to Great Falls and Cascade County.

MAR [illegible]